Craters of the Moon
NATIONAL MONUMENT AND PRESERVE

Prepare for Cold Air

A SnowSchool Pre-visit Activity - Teacher's Guide

Prepare for a SnowSchool visit to Craters of the Moon by introducing the concept of insulation, a critical animal adaption for winter survival. Students will observe the difference in heat loss between a well-insulated object and a poorly-insulated object, as well as how to prepare themselves for a winter snowshoe hike. Allow 1 hour for the activity and 15-30 minutes each for lesson introduction and post-activity discussion of results.

Objective

Students will conduct experiments and observe the differences in insulation values for a variety of materials. Students will discover factors that influence winter survival for animals and learn how to dress for an outdoor snowshoe hike at Craters of the Moon.

Curriculum Standards

Idaho Content Standards for:

Nature of Science: making observations and recording data (grades 3-7)
Biology: animal adaptation and habitat (grades 3, 4, & 7)
Math and Statistics: graphing and data analysis (grades 3-7)

Materials for each group

- 2 clean, empty soup cans of the same size (have students save these a week before the activity)
- 1 type of material for insulation (suggestions below)
- Glue
- 2 thermometers
- Hot water
- Clock or watch
- Paper and pencil
- Ruler (to make graphs)

Optional Items for more complex experiments:

- Ice cubes
- Pan or large bowl
- Fan

Possible insulating materials: 1 bag cotton balls; old socks (one cotton and one wool for comparison); 1 sq. ft. of quilt batting, polar fleece, or jean denim; or come up with your own.

Variations

This lesson can be completed in a variety of ways. With younger students it can be done as a teacher-led activity. Have students write the temperatures on the board as they are observed. Ask them which is warmer or colder.

Older students can work in pairs. Have each pair use a different type of insulation in their experiment. At the end of the activity, have students compare their findings to determine the best and worst insulator.

Other options include:

- Repeat the experiment with dampened insulating materials (to model sweat-, rain-, or snow-soaked clothing) or with a fan blowing on the samples (to model windy conditions).
- Investigate the rate of heat loss when the sample can is immersed in a larger can filled with water and ice cubes to model breaking through an ice-covered stream or lake.

Lesson Preparation

Use the following information and glossary terms to introduce students to winter ecology concepts.

Three Choices for Animals

Winter presents several obstacles to survival: scarce food, deep snow, and cold temperatures are all common at Craters of the Moon. Animals adopt one of three strategies to cope with winter: ***escape*** through migration; ***avoid*** through hibernation, or; ***adapt*** to the change in environment. This lesson focuses on adaption through added insulation to trap heat.

Staying Warm in Winter

Many animals adapt to cold temperatures by growing a thicker layer of fur. People adapt as well, wearing sweatshirts, heavy coats, boots, and stocking caps when the weather is cold, instead of the T-shirt, shorts, and flip-flops they wear in summer. Heavier fur for animals and extra layers for people both create spaces that trap air. Trapped air provides insulation and slows the rate of heat loss. An animal's fur coat often features hollow hairs, which trap air to provide additional insulation.

Staying warm in winter isn't the only way for animals to survive. Animals that adapt to winter use some or all of the following methods:

- Fat Storage - Deer eat lots in the summer when many shrubs have green, healthy leaves. Their bodies convert the food to fat. The fat helps insulate them from the cold and can be converted back to energy when there is no food to eat.
- Huddling - Small animals, like mice, sleep together with other mice in a communal nest. Heat is shared between individual animals and not lost to the cold air around them.
- Yarding - Deep snow is difficult to move through for deer and other animals with long legs. When animals *yard up* they pack the snow down in an area. Packed snow is much easier to walk on because animals use less energy than trying to wade through deep snow.

- Countercurrent heat exchange - Animals with exposed body parts, like a bird's skinny legs, risk heat loss as warm blood travels to these extremities. Heat moves from the outbound arterial supply to the returning vein, warming the returning blood. This exchange of heat helps keep the animal warm.

When People Get Cold

The normal body temperature for a human is 98.6° Fahrenheit (F). *Hypothermia* occurs when body temperature drops below 98.6°F and can be caused by prolonged exposure to the cold. Symptons of hypothermia include:

95° - 93°F: Shivering, mild confusion, and muscle incoordination.
93° - 90°F: Shivering, stumbling and slurred speech.
90° - 86°F: All shivering stops, inability to walk, cannot think rationally.
86° - 82°F: Muscles become rigid, semi-consciousness, dilated pupils.
Below 82°F: Total loss of consciousness, eventual death.

If you recognize any of these symptons in yourself or others when you are out in cold weather, get to a warm place and seek immediate help.

Glossary of Winter Survival Terms

acclimation - physiological adjustment by an organism to environmental change

adapt - to make fit for a new use, often by change or modification

albedo - the fraction of the total light striking a surface that gets reflected from that surface

antifreeze - a substance that is added to a liquid, usually water, to prevent it from freezing

aphelion - the point in its orbit when a planet or comet is at its greatest distance from the sun

avalanche - a fall or slide of a large mass of snow or rock down a mountainside

avoid - to keep from happening

basal metabolism - the amount of energy required by an individual in the resting state, such as for breathing and circulation of the blood

behavioral adaptation - a change in behavior that makes an animal better able to cope with the environment and survive

camouflage - the means by which animals escape the notice of predators, usually because of a resemblance to their surroundings

conduction - the transfer of heat or energy through direct contact from one object to another

coprophagy - double digestion through the eating of feces to extract maximum food value

countercurrent heat exchange - a counter-flow mechanism that enables fluids at different temperatures flowing in channels in opposite directions to exchange their heat content without mixing

cycle - an interval of time during which a sequence of recurring events is completed (e.g., birth, growth, development, and death)

escape - to avoid a serious or unwanted outcome

evaporation - the change of a liquid into a vapor at a temperature below the boiling point

food web - a food web depicts feeding connections (what eats what) in an ecological community

hibernation - an inactive state resembling deep sleep in which certain animals living in cold climates pass the winter; in hibernation, the body temperature is lowered and breathing and heart rates slow down; hibernation protects the animal from cold and reduces the need for food during the season when food is scarce

huddle - to crowd together, as to conserve heat

hypothermia - subnormal temperature of the body

insulation - a material or substance used to prevent the passage of heat

interrelationship - a logical or natural association between two or more things, such as a food web

migration - the seasonal movement of animals from one area to another; migration is usually a response to changes in temperature, food supply, or the amount of daylight

nivean environment - an environment dominated by the presence of snow; ***supranivean*** - the part of the nivean environment above or on the snow; ***internivean*** - the part of the nivean environment within the snow; ***subnivean*** - the part of the nivean environment beneath, below, or at the base of the snow

perihelion - the point in its orbit when a planet or comet is nearest the sun

physiological adaptation - a change in the normal functioning of a plant or animal that makes it better able to survive in its environment

predator - any animal that exists by eating other animals

prey - an animal hunted or captured by another for food

radiation - emission and propagation of energy

reflect - to throw back light or sound

rumen - The first division of the stomach of a ruminant animal, such as a deer, in which most food collects immediately after being swallowed; the food is later returned to the mouth as cud for thorough chewing

temperature gradient snow - snow in which crystal growth or change occurs at a very fast rate due to a large temperature difference across the snow pack; snow becomes *faceted* and bonds poorly, also called "*sugar snow*"

tolerant - able to withstand or endure an adverse environmental condition

torpor - sometimes called temporary hibernation, it is a state of decreased physiological activity in an animal; usually characterized by a reduced body temperature and rate of metabolism

tracks - a mark, such as a footprint, left by something that has passed

trailing - to follow a lead animal or person who does more work by breaking a trail through the snow for those that follow

wind chill - the serious chilling effect of wind and low temperature; it is measured on a scale that runs from hot to fatal to life and allows for varying combinations of air temperature and wind speed

yarding - a behavioral tactic used by deer to cope with severe winter weather; by staying in one area, trampling may expose food and make movement easier